Jessica D. Perry

From: Glenn Meyers <gmeyers@verdesolair.com>
Sent: Monday, April 14, 2014 4:54 PM
To: Stump-Web; RBurns-Web; Burns-Web; BitterSmith-Web; Pierce-Web
Cc: Jessica D. Perry
Subject: RE: Docket E-00000J-13-0375 - Workshop on Emerging Technologies
Attachments: West Union article 2013_Iowa Economic Development Authority_.pdf; Community_Geothermal_Whitepaper_for_West_Union.pdf; 2014 RTE RPS inclusion White Paper_2013_12.pdf

RE: Docket E-00000J-13-0375 - **Workshop on Emerging Technologies** (3/20/2014)

ORIGINAL

ACC Chairman and Commissioners,

Thank you for the opportunity to speak to you about the benefits of geothermal heat pump systems. Following is a brief statement about the benefits of geothermal heat pumps, then additional information as requested by Commissioner Brenda Burns, and Commissioner Bob Burns, at the end of my presentation.

Why Geothermal in Arizona?

Geothermal (or ground-source) heat pump systems would be a great benefit to Arizona in a variety of ways. The peak power demands experienced in Arizona during the summer are not an issue with ground-source heat pumps since they use the stable earth temperatures, not the ever changing outdoor air. Even the high efficient air systems of today lose much capacity when outdoor temperatures climb over 95 degrees, creating much more demand on the power grid. This may require more power generated to accommodate those demands, and much of what you heard on 3/20 requires large-scale plant construction, power storage, and a great deal of continual maintenance. The other choice is to find ways to reduce the massive peak demand - Ground source heat pumps do exactly that.

Properly installed geothermal heat pump systems do not lose capacity when temps rise outside because these systems use a "natural" storage facility - the Earth. These systems are fully functional day or night, everyday of the year. The buried loop field of tubing releases heat from buildings in the summer, and pulls in heat from the ground in winter. These loop fields have a laboratory tested half-life of over 100 years, with NO maintenance required. The equipment attached to the loop field maintain the highest efficiencies available today - and those efficiencies remain very constant.

Geothermal (ground source) heat pumps not only reduce demand, and increase savings, but may provide another revenue opportunity for Arizona utilities. Being a partner to homeowners and business owners in the ground loop field is a <u>proven</u> option. The buried loop field could be another easement that land owners are not concerned with anyway. Since loop fields are buried and sealed, they are MAINTENANCE FREE and tamper proof. Considering the longevity of these loop field systems the additional savings and revenue would be realized for several decades. Following in this email, and in some of the attached literature, is more information concerning this very approach.

More information as requested by Commissioner Brenda Burns, and Commissioner Bob Burns.
(1) Commissioner Brenda Burns mentioned a concern about my comment regarding the benefit of converting more Northern Arizona residents and businesses from gas to the grid/utilities for heating. Understandably, the assumption was taking customers from the natural gas utilities and moving them to the electric utilities. I was referring to the large number of LP users in the cooler climates in our state. I hope this helps to clarify, and to show the benefit to all.

(2) Commissioner Bob Burns asked for more details about utilities in other states who are actively pursuing the ownership of geothermal loop fields in utility easements on both residential and commercial properties. Following are a few examples -

Wyndotte, MI - This city offers a geothermal utility service. See the article about this - http://contractormag.com/news/geothermal-utility-1234

Western Farmers Electric Cooperative, NM - They are offering a thermal services program to their member coops in which they will pay to install the loop field and charge a monthly fee to the homeowner and/or business owner.

Touchstone Energy - working with Coops such as Western Farmers to offer these services.

West Union Iowa - This town installed a district geothermal loop in their downtown area. (See attached articles)

Panterra Energy, CO - A private company registered as a utility in Colorado offering geothermal loop field partnership.

Tri-State Generation and Transmission - The last attachment is a white paper making the case for ground source heat pumps to Tri-State who supplies power to coops in 5 states.

There are other examples if more information is needed.

Thank you for your time,

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Feature Story

West Union, Iowa:
Small town, big vision

Jeff Geerts, Special Projects Manager, Iowa Economic Development Authority

Imagine a town with a distributed-loop ground source heating and cooling system connected to 60 downtown buildings. LED street lights. An electric vehicle plug-in station. Porous paver streets and sidewalks combined with 36,000 sq ft of rain gardens. A new civic plaza to celebrate community pride and events. Dozens of storefronts being restored and upper-story housing opportunities being created.

Where is this place? The Pacific Northwest? New England? Europe? No, it's actually in Iowa. West Union is a community in the far northeast corner of the Hawkeye State filled with community pride and a determination not only to survive, but to thrive. This is the story of how a town with just under 2,500 inhabitants established itself as an international demonstration site for sustainable community practices, including a district geothermal energy system.

A Community Project

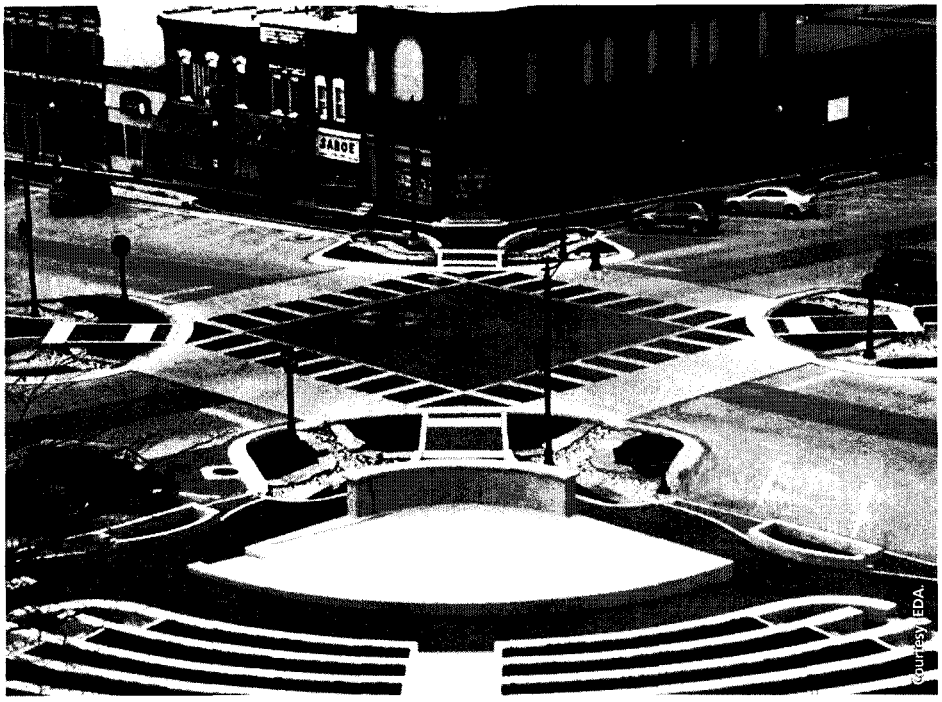
West Union is one of 48 Iowa cities and towns designated as a Main Street Iowa Community. The mission of the Main Street Iowa program is to improve local social and economic well-being by helping selected municipalities capitalize on the unique identity, assets and character of their historic commercial districts. The program follows the Four-Point Approach® developed by the National Trust for Historic Preservation that emphasizes economic restructuring, design, promotion and organization. The national Main Street program is franchised to the Iowa Economic Development Authority (IEDA) Downtown Resource Center; West Union has its own organization called Main Street West Union whose mission is to preserve and enhance the vitality of its downtown through the education and encouragement of all citizens to work together to promote the community as a vibrant place to shop, work and live.

In 2007, West Union was in the early stages of conceptual design for a street and streetscape improvement project for its downtown district. City staff approached Main Street West Union with an interest in streetscape improvements and asked the organization to seek out funding opportunities. At this same time, IEDA's Community Development division was embarking on a journey to integrate green, sustainable practices into its various community programs and services, and learned about the West Union initiative.

In March 2008, the IEDA approached the city of West Union, Main Street West Union and others to become a pilot green demonstration community for the purpose of implementing a variety of integrated, sustainable strategies as an inspiration and laboratory from which other communities could learn. IEDA asked the city to commit to the approximately $4 million previously included in a city council resolution for the downtown street and streetscape project. IEDA indicated it would assist the city in leveraging funding for additional costs, if any, for project design and construction that resulted in a holistically integrated demonstration of model green, sustainable practices. Within days, the city sent a letter to IEDA signed by more than 20 local parties representing the city of West Union, West Union Chamber of Commerce, Main Street West Union, Fayette County, West Union Development, the *Fayette County Union* newspaper and local businesses expressing an interest in serving as a pilot green demonstration community.

Community Visioning Workshop

Encouraged by significant local and state interest, a two-and-a-half-day visioning workshop was held in West Union in June 2008. Its purpose was to encourage a more sustainable approach to community infrastructure redevelopment (both public and private), including the upcom-



The main intersection of downtown West Union features newly installed porous pavements, lighting, a civic plaza, traffic-calming measures and buildings preparing for façade restorations.

District Geothermal System Design Team and Consultants

- Conservation Design Forum
- IBC Engineering Services
- KCL Engineering
- Midwest Energy Solutions
- National Renewable Energy Laboratory Technical Assistance Program
- National Trust for Historic Preservation Green Lab
- Tom Osdoba, consultant
- TeKippe Engineering
- Tri-County Refrigeration

ing six-block streetscape project on Vine Street (the town's main street).

To support the visioning effort and facilitate the workshop, the IEDA hired Conservation Design Forum, a firm specializing in ecological restoration practices. In addition, IEDA brought to the table a variety of experts from the Iowa Department of Cultural Affairs, Iowa Department of Public Health, Iowa Department of Agriculture and Land Stewardship, and U.S. Department of Agriculture Rural Development. Others informing the process along the way included the Iowa Department of Transportation, Iowa Department of Natural Resources, Natural Resources Conservation Service and Upper Iowa University. Having these outside resources available exposed the community to state-of-the-art practices from around the country. A key outcome was the establishment of the following "first principles" for the pilot green demonstration project:

1. collaborative process
2. sustainable community investment
3. great setting for local business
4. healthy natural environment
5. beauty crafted into West Union
6. vibrant economy for Northeast Iowa
7. West Union's unique context
8. inspiration through education

This brainstorming process yielded numerous ideas for improving the economic viability, safety, aesthetics and sustainability of the downtown core. Among these were suggestions for implementing a geothermal system to heat and cool buildings and melt snow and ice on streets and sidewalks.

Discerning a high level of interest in such a system, IEDA secured funding from the USDA Rural Community Development Initiative to hire IBC Engineering Services to conduct a feasibility study for the district system. The study examined four approaches to district geothermal including two that involved a hybrid geothermal system with supplemental heat that would serve as a snow-melt system for sidewalks and streets. The snow-melt system was ultimately ruled out due to its annual operating cost, but the city continued to explore a district geothermal system as one means of improving energy efficiency for downtown businesses and property owners.

Simultaneously with the feasibility study, Main Street West Union worked closely with Black Hills Energy, provider of natural gas service to downtown customers, to conduct energy audits of approximately 85 percent of downtown properties. As a followup to the audits, IEDA awarded a pass-through grant to Main Street West Union to provide downtown properties additional energy efficiency improvement incentives beyond the quality incentives already offered by Black Hills Energy and Alliant Energy, the local electric utility. Energy audits were performed, and some of the incentives (in the form of rebates) provided were for purchases of high-efficiency furnaces, boilers, lighting and insulation, but the next question was how to make the most of those audits and incentives.

To help property owners maximize their potential energy savings, IEDA, the city of West Union and Main Street West Union teamed up once again. In partnership with Cenergy, a Residential Energy Services Network (RESNET)-certified Quality Assurance Designee, training was provided to local insulation installation contractors as well as air-balancing and diagnostics training to local HVAC contractors that emphasized proper sizing and installation practices.

Building the District Geothermal Network

The community now had a feasibility study for the district geothermal system, completed energy audits, training for local HVAC firms and a financial incentive program. The next big pieces of the puzzle were funding the district geothermal infrastructure and assisting property owners in adapting their HVAC systems to utilize the district system.

Once again the city of West Union and IEDA teamed up, this time to hire an experienced grant writer to help project partners pursue funding for various components of the larger community vision. This turned out to be a very wise move. Thanks to the funding sources identified during the visioning workshop and the onset of federal and state stimulus programs in 2009, more than $7.5 million of the $10.2 million street, streetscape, civic plaza and district geothermal system was leveraged from outside sources.

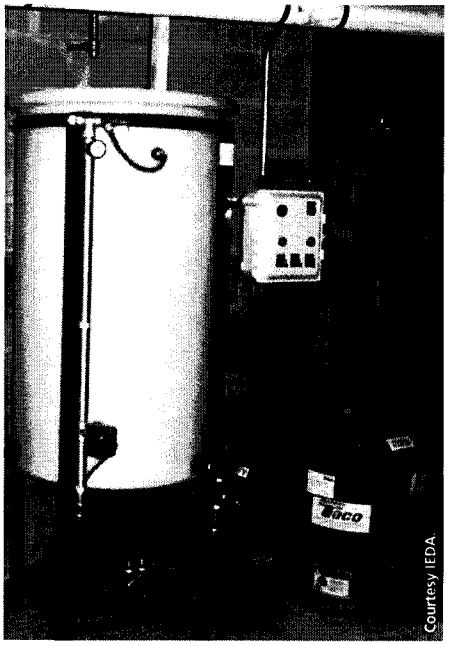
In 2010, the project received $1 million in Community Development Block Grants, $1 million in DOE Energy Efficiency Conservation Block Grant funds, a $100,000 Main Street Iowa Challenge Grant and $500,000 in EPA Climate Change Showcase Community funds. Collectively, these funds covered the public infrastructure components of the district geothermal system and provided $100,000 to help property owners in making energy efficiency improvements. The city now had funding for the public components of the district geothermal system, and building owners had energy audits and the prospect of energy efficiency incentives available from the local utilities, Main Street West Union and DOE. However, no property owners had yet committed to using the system. Why? There were still too many unknowns.

Property owners didn't know how the system was going to be governed, what the rate structure would look like or the cost of the necessary building modifications, heat pumps and related accessories. As a consequence, they could not calculate the payback period or return on investment. Without this critical information, they were not comfortable committing to the new system.

In 2011, key steps were taken to provide reassurance to potential customers. The city continued to tighten the specifications for the district geothermal system well field to ensure the most efficient construction possible. Well field construction was bid out in late 2011, a contractor was selected in early 2012, and the well field was constructed between spring and early fall 2012. Meanwhile, IEDA applied to the USDA's Energy Audit-Renewable Energy Development Assistance program for funding to provide services that would result in a greater comfort level for downtown property owners to commit to use of the district geothermal system. The USDA application was approved, providing technical assistance and a business case statement to each of 23 interested individual property owners. Technical assistance services provided in 2012 included

- air infiltration testing and energy efficiency improvement opportunities (with 25 percent of the cost to be matched by building owners);
- TRACE 700™ energy baseload calculations;
- a line schematic of recommended building HVAC system modifications;
- cost comparisons of installing and maintaining a system similar to each building's existing HVAC system versus installation of heat pumps and modifications to use the district system (based both on current utility rates and an average of current rates and historic rates);
- a first-cost and energy-savings value with and without incentives applied;
- simple payback period analysis;
- written design specifications and narrative for property owners committing to the system;
- analysis of district geothermal system operation, maintenance and administrative costs to calculate user fees for each property; and
- exploration of several system governance structures.

A film crew has been documenting the installation of the district geothermal system for a 30-minute video to be completed in 2013.



District geothermal system glycol tanks are located in the basement of the county courthouse building.

West Union will own the infrastructure and lease the system to a new limited liability company comprised of system users.

By fall 2012 the scope of the system and its governance structure became much clearer. Eleven property owners committed to using the district system once it became available in spring 2013; three additional property owners signed letters of intent to use the system in future years but not likely in 2013. The city of West Union will own the infrastructure and lease the system to a new limited liability company comprised of system users. The city has calculated an annual system usage fee based on committed load and the load calculations for those businesses to cover operations and maintenance, along with an evenly distributed fee among users to cover administrative costs.

The city has also established qualification requirements for any HVAC contractor installing or maintaining in-building systems connected to the district geothermal system. The user group will hire a third party to maintain and operate the system and work together to bid out group purchases of the heat pumps, affiliated equipment and installation services. The two local banks have unveiled an energy efficiency and façade improvement financial assistance program, making funding available at 0.75 percent above the prime lending rate for a period of five years, after which any remaining balance can be refinanced at prevailing rates.

Project Evaluation and Upcoming Activities

Since West Union is serving as a pilot green demonstration community, a variety of approaches are being taken to evaluate the outcomes. Data is being tracked to assess the economic impacts of the overall project. A formal market analysis, completed prior to project initiation, identified high-performing sales categories in the community as

West Union District Geothermal System Timeline

Date	Activity
Spring 2008	Community visioning session held
Summer 2008-Spring 2009	District geothermal system feasibility study conducted
Summer 2008-Spring 2009	Utility provides checklist-based energy audits
Fall 2008-Ongoing	Main Street West Union establishes energy-efficiency incentives
2009-2010	Overall project design continues
2009-2012	Multiple funding applications submitted
Fall 2009	Community Development Block Grant awarded for district system
Spring 2010	DOE Energy Efficiency and Conservation Block Grant awarded
Spring 2010	EPA Climate Showcase Community Grant awarded
Fall 2011	USDA Renewable Energy Development Assistance Grant awarded
Winter 2011-2012	Well field construction out for bid
Spring 2012-Fall 2012	Well field constructed
Spring 2012-Fall 2012	USDA-funded technical assistance and business case services provided to initial group of 23 property owners
Fall 2012	First property owners commit to district geothermal system
Fall 2012	System users establish formal users' entity
Winter 2012-2013	System users bid for equipment and installation services as a group
Winter 2012-2013	City leases system to system user entity (proposed at press time)
Winter 2013	User entity contracts with third party to operate and maintain system
Spring 2013	District geothermal system begins operation
Summer 2013	West Union project documentary film released

West Union's District Geothermal System

- Closed loop, 300-ft-deep wells
- 132 wells (22 circuits) on courthouse square – 264 tons (installed)
- 252 future wells at Lions Park – 504 tons (future expansion – distribution lines and pump house already installed, but no wells at this time)
- 8-inch supply and return lines through streets
- 2-inch to 6-inch service lines stubbed into all 60 downtown buildings
- Circulation pump/controls in courthouse basement and pump house installed in Lions Park for future system expansion
- Approximately 60 buildings in project district with a total of approximately 330,000 sq ft, 11 commitments for 2013 startup, three commitments for future years

Source: IEDA.

well as underperforming sales categories where sales were being lost to other communities in the region, indicating potential niche development opportunities. Additional data being tracked and analyzed from before project conception to post-construction includes retail sales, building vacancy rates, property assessment values, building use changes (e.g., residential to retail, retail to professional services, etc.) and new businesses, business expansions and business closures.

To track potential changes in behaviors and attitudes about downtown West Union, the IEDA contracted with Urban Imprint in 2011. Study approaches include the Irvine Minnesota Inventory (a built-environment audit tool), pedestrian and vehicle observations, and residential and business surveys. The behavior impact information, combined with the economic and environmental impact analysis, will assist in guiding communities in targeting future sustainable community development activities to generate the greatest impact. The behavioral and attitudinal impact analysis includes the following:

1. identify the significant social impacts of the green, sustainable practices implemented;
2. identify key changes in behavior, attitudes and preferences facilitated; and
3. provide targeted rationale and recommendations for future green, sustainable practices/programs by IEDA.

West Union's foray into community energy was begun prior to the release of IDEA's publication *Community Energy: Planning, Development & Delivery.* Having this comprehensive guide in advance would have been helpful and might have stimulated additional possibilities. IEDA will continue to share its results with IDEA as the project becomes fully implemented in 2013. Further documentation will include a 30-minute video documentary, a white paper and a community energy efficiency workshop to be hosted in West Union this summer. These efforts may inspire other small communities to think big as they develop their own vision for a more sustainable future.

Jeff Geerts is a special projects manager with the Community Development Division of the Iowa Economic Development Authority (IEDA). He facilitates the incorporation of green sustainable community practices into each of the division's team areas so that environmental sustainability considerations are part of the everyday functions of the division and its services. Prior to joining IEDA, Geerts was a program planner with the Iowa Department of Natural Resources Energy and Waste Management Bureau, where his responsibilities included providing waste reduction and recycling assistance, working with the Iowa beverage container deposit law, and managing the Iowa Scrap Tire Program and the Iowa Waste Exchange. He holds a Bachelor of Science degree from St. Ambrose University in Davenport, Iowa, and a Master of Public Administration degree from Drake University in Des Moines. He can be reached at jeff.geerts@iowa.gov.

West Union, Iowa District Geothermal Heating and Cooling System

August 2013

Prepared By:
Jeff Geerts, Special Projects Manager
Iowa Economic Development Authority

IOWA economic development

Contents

Project Background

West Union is a small Iowa town of less than 2,500 people that typifies many primarily agriculturally-based rural communities. West Union is a Main Street Iowa community and the Fayette County seat. The people of West Union have a long standing history of deeply connected civic pride and leadership and have maintained very high quality community amenities and services. As the community has aged, it once again became time to renovate and improve "Main Street" (actually Vine Street) and other downtown infrastructure assets.

The city's leadership is pursuing a new, sustainable approach towards improving infrastructure that will provide a range of benefits, and serve the citizens and merchants of West Union well beyond the time when traditional infrastructure typically needs replacement or reconstruction.

A Unique Opportunity

A number of related factors recently aligned that, in combination, presented West Union with a truly unique opportunity to develop leading edge green, sustainable community infrastructure:

First, the city determined in 2007 the need to replace streets, sidewalks, utilities, and stormwater management systems in the downtown as a matter of first priority.

Second, recent events throughout the country have underscored the vulnerability of conventional infrastructure and land management practices, resulting in flooding, property loss, and environmental degradation. A range of applications and materials in urban green infrastructure sustainable practices are becoming widely available throughout the country. These practices improve the performance and reduce the perpetual maintenance and operations costs of community infrastructure, while doing a superior job of protection and restoration of the environment and ecological functions.

Third, interest in promoting improved public health, more efficient use of limited infrastructure dollars and decreasing transportation costs is driving a national complete streets movement placing an emphasis on streets designed and operated to enable safe access for all users including pedestrians, bicyclists, and motorists of all ages and abilities.

Fourth, rapidly rising energy costs in previous years has placed a national emphasis on energy efficiency and local energy generation.

Fifth, studies have shown that communities are better served from a fiscal standpoint with pedestrian scale, multi-purpose streets. Retail sales are better in shopping areas served by safe, attractive streetscapes. Tourists are drawn to these kinds of authentic town settings. Property values are increased as well.

And, finally, In October 2007, the Iowa Economic Development Authority's (IEDA) Main Street Iowa program completed a Technical Assistance Visit to advise West Union about the potential for multipurpose pedestrian-scale streetscape improvements. In the winter of 2008 IEDA was seeking one or more communities to be a Pilot Green Community. The department realized that West Union with its existing interest in streetscape and other infrastructure improvements combined with the local leadership and coordination of the Main Street West Union organization was perfectly poised to be a Pilot Green Community. IEDA selected West Union in March 2008 as a Pilot Green Community to demonstrate an integrated, multi-faceted approach to green, sustainable revitalization of downtown. With the community on board as a Green Pilot Community, IEDA hired consulting firm Conservation Design Forum to facilitate a 2.5 day

visioning session in June 2008. The result of the June 2008 visioning session was the initiation of many of the project concepts included in the eventual project as well as development of the community's First Principles for future development activities.

Integrated Community Elements
During the visioning workshop, a number of desirable community elements, or components of a sustainable streetscape, were presented, discussed, and prioritized. A list of top priorities and strategies emerged from the dozens of ideas discussed. The following ten areas represent the consensus of the group with respect to those community elements most essential to West Union's successful green infrastructure initiative.

1. **Optimal Street Design and Dimensions**
    a. Pavement Width - two driving lanes with center "flexible" lane for parking, standing, deliveries, snow storage, etc.
    b. Snow removal - consider snow melt system using renewable energy sources
    c. Accommodate bicycles - bike lanes and storage
2. **Parking/Access**
    a. Parking - angled parking along outside edges - consider back-in diagonal parking for safety
    b. Pursue off-street parking opportunities and parking management to maximize patron convenience
3. **Pedestrian Safety and Comfort**
    a. Crosswalks clearly delineated at intersections and mid-block
    b. Consider speed tables for traffic calming
    c. Add bump-outs at all mid-block locations
    d. Trees/shading; perform solar study to determine optimal solutions
4. **Water**
    a. Integrate porous pavement unit pavers
    b. Rainwater harvesting and re-use
    c. Rain gardens/bioswales
5. **Energy/Communications Infrastructure**
    a. Geothermal loop to serve entire square
    b. Conduit for communications
    c. Wireless system
    d. Energy audit for local businesses and property owners
6. **Street Lighting**
    a. Utilize energy efficient, pedestrian-scaled lighting standards
    b. Adapt lighting design to maximize safety and minimize light pollution, glare, and non-renewable energy use
7. **Public Art**
    a. Integrate art into the streetscape in a variety of ways
    b. Use art to tell the story of West Union's past, present, and future
    c. Craft unique street furnishings and amenities with local artists and craftsmen
8. **Recreation Options**
    a. Multi-use bicycle lane/trail connections into town square
    b. Utilize the courthouse lawn as public space
9. **Communications**
    a. Develop and implement community communications strategy
10. **Implementation/Funding**
    a. Pursue range of support/funding opportunities

Project Goals

First Principles

To fulfill the community's project vision and prepare for the likely event that tough design and budget decisions would need to be made, West Union established the following eight First Principles to guide planning and decision making.

1. Collaborative Process
    a. Work together to create great public and private space that serves the community.
    b. Incorporate West Union's committed leadership and their local knowledge with an experienced team of professionals.
    c. Realize West Union's green vision through an integrated planning, design, and implementation process.
2. Sustainable Community Investment
    a. Maximize the economic value, ecological performance, and energy efficiency of every surface, element, resource, and material in West Union.
    b. Deploy cost effective, multiple-benefit, multiple-purpose improvements with durable, lasting techniques and materials.
    c. Invest in energy efficient structures and systems with a greater reliance on renewable energy sources.
    d. Ensure resource-efficient implementation and operations/maintenance.
    e. Secure a wide range of support and supplemental funding through a wholly integrated green approach.
3. Great Setting for Local Business
    a. Develop the public realm in a way that is supportive of shops, restaurants, and other local businesses and commerce located in West Union.
    b. Prioritize pedestrian safety, comfort, and enjoyment.
    c. Ensure each business and amenity is accessible to all.
    d. Provide ample seating.
4. Healthy Natural Environment
    a. Incorporate natural systems to enhance all public space.
    b. Integrate healthy water, trees and ornamental plantings to all places.
    c. Treat all water as a valuable resource; incorporate rainwater into the public realm in a visible way.
    d. Plan public spaces to be used for a variety of community activities.
5. Beauty Crafted into West Union
    a. Make all infrastructure and amenities both functional and beautiful expressions of West Union so that it endures.
    b. Nurture a guild of local artists and craftsmen to craft beautiful, durable infrastructure to serve the community.
    c. Develop "complete streets" that provide transportation options and full accessibility for all uses and citizens in a beautiful way.
6. Vibrant Economy for Northeast Iowa
    a. Cultivate local enterprise, art, and craftsmanship to support and enhance the economy of Northeast Iowa.
    b. Create an economically diverse, sustainable commercial district where goods and services are available in the community, with an emphasis on locally grown and produced products.
7. West Union's Unique Context
    a. Enhance awareness and appreciation for West Union's unique natural and cultural history.

b. Integrate public art, water, landscape, buildings and infrastructure with cultural references in a way that helps preserve and interpret the community's rich heritage.
c. Reinforce West Union's character and sense of place.
d. Connect with Northeast Iowa's regional trail infrastructure.

8. Inspiration through Education
   a. Educate about sustainable community living through practical demonstration.
   b. Inspire all residents — individuals, families, youth, and seniors — and enfranchise them in West Union through the renewal of the community.

Why District Geothermal?

Participants in the June 2008 community visioning for downtown were looking for ways to support and enhance the downtown businesses and brainstormed that a district geothermal heating and cooling system might make sense and be attractive to downtown property owners. Visioning attendees believed that in 2008 the upfront costs of solar combined with utility regulations would likely make solar a less competitive option. Attendees also recognized that according to wind asset maps the West Union immediate vicinity did not appear to have wind assets to make that a viable option combined with the difficulties of locating a large source of wind generation in or near a downtown. The community also did not have any large producers of by-products such as steam, hot water or methane near downtown that could support any other type of district system. While the community may lack wind or byproducts supporting energy efficiency or renewable energy, the courthouse square, a nearby city park, a former middle school site, alleys and a large church parking lot provide numerous opportunities for geothermal well fields to be installed.

In 2009, IBC Engineering Services completed a USDA Rural Community Development Initiative funded study to determine the financial feasibility of a District Geothermal Heating and Cooling (DGHC) system for downtown West Union. The study determined that if approximately 30 percent of downtown's total building square footage estimated at 300,000 participated in the system, that the system could be viable.

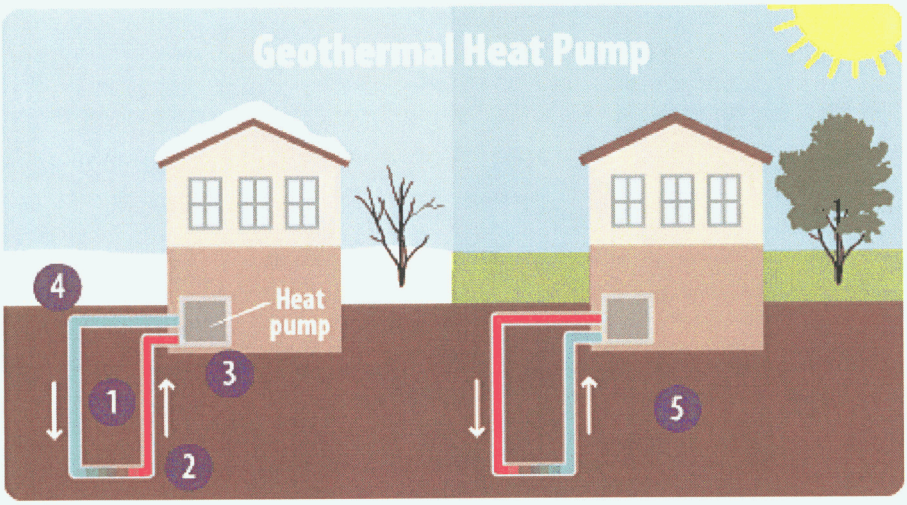
An important aspect that separates geothermal from the options considered is that geothermal in Iowa is not a renewable energy system, but instead an energy efficiency measure with the ability to make a building's heating and cooling system 300-400 percent efficient.

A way to understand how this increased energy efficiency works can be applied to a conventional residential air conditioning condensing unit. A residential air conditioning unit is a heat pump, as it uses a refrigerant to cool a space it rejects heat through the condensing unit. The condensing unit uses a fan at the top to reject heat to the outdoor space that it is installed in. A geothermal heat pump, in contrast, uses a fluid to reject heat to the ground. The heat is stored in the ground and can be extracted during the heating season to increase the efficiency of the heat pump. As a comparison between a conventional heating and cooling system:

	Residential Unit	Geothermal Heat Pump
Heating COP	0.8-0.9	3.0-4.0
Cooling EER	15-18	30-40

A heating COP is a coefficient of performance and the cooling EER is an energy efficiency ratio. COP is defined as the output of energy divided by the input of energy. In a gas-fired heating unit, like the furnaces used in many homes and small businesses in Iowa, 80-90% of the gas input to the unit could be converted to heat a space with the remaining rejected as waste in the combustion exhaust. Being able to reclaim stored energy in the ground can result in 300-400% improved performance to heat the space. Likewise, there are higher efficiencies on the cooling side of the heat pump; however, not quite as efficient as heating. The basis of the system is a more efficient use of energy by allowing the use of energy that would typically be wasted.

District Geothermal System and How It Works



Source: Environmental Protection Agency, http://www.epa.gov/climatestudents/solutions/technologies/geothermal.html

1. Water or a refrigerant moves through a loop of pipes.
2. When the weather is cold, the water or refrigerant heats up as it travels through the part of the loop that's buried underground.
3. Once it gets back above ground, the warmed water or refrigerant transfers heat into the building.
4. The water or refrigerant cools down after its heat is transferred. It is pumped back underground where it heats up once more, starting the process again.
5. On a hot day, the system can run in reverse. The water or refrigerant cools the building and then is pumped underground where extra heat is transferred to the ground around the pipes.

A geothermal system is typically comprised of three major components, the geothermal source, the heat pump or heat exchanger, and the air distribution to meet the heating or cooling demand within a building. This system is considered to be a district system because one of these components is shared between multiple users, namely the geothermal well field and associated geothermal fluid distribution.

The system takes advantage of the ground as thermal energy storage with the use of vertical piping in bores, similar to a radiator, to transfer temperatures from the fluid in the piping to the surrounding earth. Six vertical bores are connected together to form a zone, and multiple zones

are connected to create a geothermal field. The field is connected to distribution piping installed beneath Vine and Elm streets, extending north to Lions Park where infrastructure has been installed to be able to expand the system as demand for the system grows. From the distribution piping, service laterals are provided to the end users for connection of their equipment.

Each of the end users is responsible for their own equipment inside the building and distributing the heat and cooling inside their building. By tapping this constant source of heat from the earth in the winter, and injecting heat into the earth in the summer, **geothermal heat pumps can reduce heating costs by 40 to 70 percent and cooling costs by 30 to 50 percent** compared to conventional systems. [Source: U.S. EPA Federal Register: May 23, 2002 (Volume 67, Number 100)]

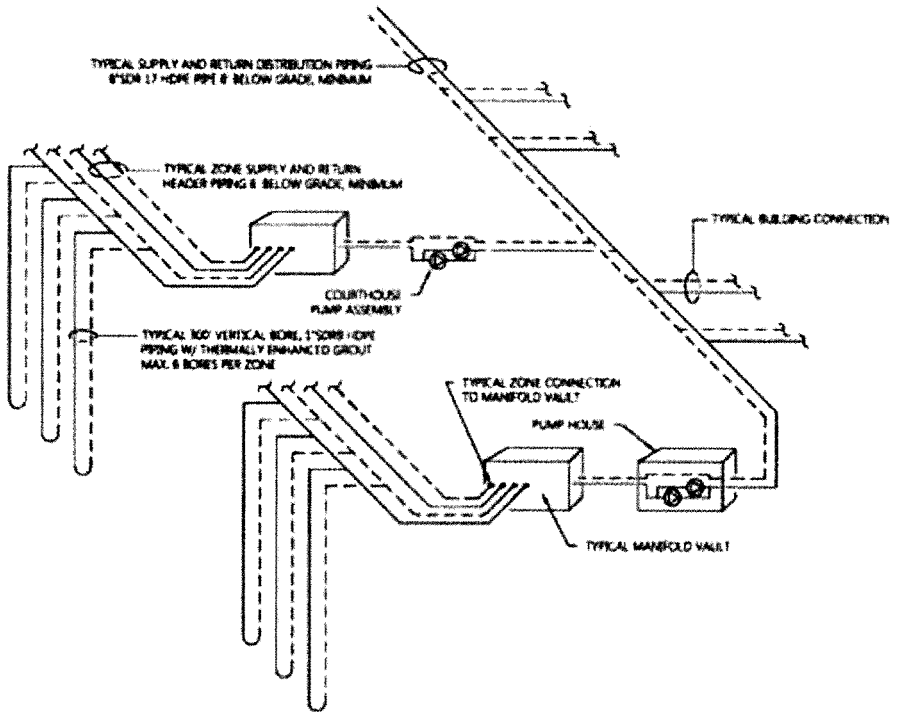
Project Facets — Location, Size, Capacity

The DGHC system is installed throughout downtown West Union. The central geothermal field is in the Fayette County Courthouse green space to the southwest, west, and northwest of the courthouse building. Distribution lines are also installed from downtown north to city owned Lions Park where an additional pump house was installed in anticipation of future expansion opportunities towards the regional hospital and school facilities.

The system fluid, mixture of 75% deionized water and 25% food grade propylene glycol, is circulated through eight inch diameter supply and return lines located under the new porous paver system streets and then is available to be piped into the basement of 57 downtown buildings through service lines ranging from two inches to six inches in diameter depending on the anticipated energy load of the building on the system.

Here is a bulleted summary of the community owned system components.

- Courthouse geothermal field
  - Circulation pump/controls in courthouse basement.
  - Manifold vault as a central point of connection for the zones to single point entry into the courthouse basement.
  - 132 bores assembled in 22 zones for approximately 264 tons of cooling capacity, assuming two tons per bore.
- Lions Park geothermal field
  - Pump house with circulation pump/controls.
  - Manifold vault for future field connection.
  - Provisions for future field of approximately 252 bores for approximately 504 tons of cooling capacity.
- Distribution system
  - 8" dia. supply and return lines as a district manifold for geothermal field connection and connection of end users.
  - 2"-6" dia. service lines stubbed into buildings for end user connection.
  - 57 buildings have system stubbed into basement with 3 buildings have system available just outside the building envelope.
  - 2 stubs for future geothermal fields.
- 13 property owners have committed to system use with 10 properties starting use of the system in 2013 with a combined estimated heat pump size of 120 tons in the first phase.
- 50% of installed system capacity is anticipated to be used by the 10 committed users.



West Union District Geothermal Schematic Detail

District Geothermal Benefits — City, Property Owners, Business Owners

The district geothermal heating and cooling system is intended to deliver several benefits for different stakeholders within the community.

For the city, the system is seen as a competitive advantage to retain existing downtown businesses and to recruit new development. The system also may one day become a revenue source for the community as the system expands beyond downtown. Another reward for the risk taken by the city is the national recognition of being a leader in sustainable efforts.

For property owners, the system can be a way to reduce utility costs and an incentive for retaining and recruiting tenants. The new system will also provide greater indoor comfort, climate control and air conditioning where it may not have existed before. Business owners and upper-story residents will also benefit from greater comfort and climate control and an expanded opportunity to control utility costs and reduce internal noise from heating, ventilation and air conditioning equipment.

Role of City in Making District Geothermal Happen

The city of West Union played several key roles including fiduciary, researcher, informer, and policy formulator as the lead entity establishing the DGHC system. The city sought and received outside funding for the system's feasibility analysis and installation of all the distribution components including the well field, pumps, and distribution piping. The city administrator researched other district systems around North America and sought out consul from those communities and the entities operating those systems.

Community residents, property owners and business owners were provided numerous opportunities to learn about the system and ask questions and a DGHC flyer was prepared for and provided to all downtown property owners. And as policy formulator, the city once again sought out outside district system development expertise to help formulate the system's governance and rate structures and the city strongly promoted using the district system to property owners seeking city incentives for reinvestment in downtown.

Securing System Users

Securing system users and developing the rate and governance structure for the system have been the two biggest challenges for the project. Many factors make securing system users a challenge.

The first factor is that most of the property owners are also small business owners with little knowledge of or time dedicated to switching their building's heating and cooling system to geothermal. A second factor is that the subject buildings are very diverse in their current heating, ventilation and air conditioning systems making it difficult to provide generalities about the necessary steps to convert each building to geothermal and the anticipated costs and return on investment from that conversion. Factor three is that many of the buildings are already operating quite efficiently in part due to early 20th century construction practices and in part due to a lack of any existing mechanical ventilation systems and air conditioning in many buildings. A fourth major factor complicating securing system users was a lack of a pre-determined rate and governance structure for using the system; thereby, prohibiting property owners from being able to fully calculate potential return on investment because the full cost of using the system is unknown. The ability of property owners to fund the necessary interior capital improvements to the building's HVAC system is a fifth factor challenging securing system users. A final factor complicating securing system users is the existing relatively low cost of energy in West Union and the depressed natural gas prices that have occurred between when the system was first envisioned in 2008 and 2013 when the system is ready to begin operation. In order to address the factors above, a series of services and incentives were developed and implemented to make committing to using the system as easy as possible for the potential users.

First, West Union businesses were provided basic checklist type of energy audit services by Black Hills Energy the local heating fuel supplying investor-owned utility. Second training was provided to local contractors on high quality installation practices for insulation and HVAC systems to make the most of energy efficiency retrofits recommended in the energy audits. Third, downtown businesses were offered higher level energy audit and infiltration testing services that utilized USDA Rural Energy for America Program (REAP) funding and local incentives and 25 percent building owner match to identify opportunities to reduce building base load and improve thermal comfort. Fourth, Main Street West Union, the Iowa Economic Development Authority and USDA REAP teamed up to offer nearly two dozen properties targeted for DGHC system use a set of services that included base load energy calculations, analysis and recommendations of needed HVAC system modifications to use the DGHC system, and estimated cost of the system improvements, anticipated energy cost savings based on an estimated system use cost and the possible return on investment. Essentially, a business case model was prepared for each property owner to assist them in making an informed decision about using the DGHC system. Fifth, Main Street West Union, the Department of Energy, and local banks teamed to offer financial incentives including grants and loans at .75 percent over prime lending rates. And the sixth and final piece of the integrated and comprehensive approach to securing system users was the contracting by the city with FVB

Energy for outside expertise in developing district system rate and governance structures to establish formal expectations and costs for all parties resulting in peace of mind and risk mitigation for the city and system users.

The challenging factors and solutions to securing system users are presented below.

Challenging Factor	Solution
Property owner lack of geothermal system time and knowledge	Education and information dissemination, provision of energy system audit and design services
Diversity of existing building HVAC systems	Providing building-by-building evaluation and design services to build individual business case per building
Efficiency/low cost utilities of existing buildings	Identified opportunities to improve efficiencies and thermal comfort, shared DGHC system, grant and financing incentive program
Lack of established governance and rate structure	Hired outside expertise to develop proposed rate and governance structure
Lack of upfront funding	Grant and financing incentives for property owners

Project Characters and Partnerships

West Union's approach to establishing the DGHC system was somewhat unconventional. Typically, a community considering a district energy or energy efficiency system would retain outside consulting services early on from an experienced district system development consultant. The process would ideally follow these system development steps in the *Community Energy: Planning, Development, Delivery* publication from the International District Energy Association.

Stage 1 Objectives setting
Stage 2 Data gathering
Stage 3 Project definition
Stage 4 Options appraisal
Stage 5 Feasibility study
Stage 6 Financial modeling
Stage 7 Business modeling
Stages 8, 9 and 10 Marketing and business development; Project procurement; and Delivery

In West Union's case, none of the individual partners had extensive comprehensive experience in planning, development and delivering a district energy efficiency system, but because of the number of partners involved and the diversity of the experience amongst those partners and the contacts of those partners, West Union was able to plan and develop much of the system within the existing downtown redevelopment project team.

The following while not a comprehensive list of all the partners involved in the overall downtown revitalization project, does represent the extensive project team involved in the DGHC system and their roles.

DGHC Project Team	Role
System Design	
Conservation Design Forum	project designer
IBC Engineering Services	project designer and feasibility study
KCL Engineering	property base load calculations, internal building system design and sizing, business case models
Fehr-Graham Engineering	project designer and manager
Tri-County Refrigeration	project consulting on operations, maintenance
Construction Team	
Blazek Corporation	general contractor
K2 Construction	well field installation
Service Providers/Partners	
Black Hills Energy	energy audits
Cenergy	insulation and HVAC installation training
Department of Energy	technical assistance
Dorsey & Whitney, LLP	lease agreement consulting
Enerjyn	grant writing
FVB Energy	rate structure
Holophane	lighting selection
Main Street West Union	education, outreach
Midwest Energy Solutions	energy auditing and infiltration testing
National Center for Appropriate Technology	energy efficiency video
Preservation Green Lab	technical assistance
The Energy Group	energy case studies
Urban Imprint	behavioral research
West Union, City of	project management
Funders	
Department of Energy	Energy Efficiency Conservation Block Grant
Environmental Protection Agency	Climate Showcase Communities
Iowa Economic Development Authority	Community Development Block Grant, Main Street Challenge Grant, I-JOBS
USDA	Rural Energy for America Program, Rural Community Development Initiative

Quotes and Testimonials

This downtown revitalization effort has a lot of features that are going to be helpful to my business including the shared geothermal heating and cooling system that will make it less expensive to heat and cool. Plus the district geothermal system is going to make it easier to rent and keep rented the rental units I own. There are a number of other benefits of the downtown revitalization effort. Hopefully it will attract new businesses and people to town so it will mean more customers for us to work with and we're are excited to see the changes to structures downtown to refurbish them and bring new life to our downtown.

- Dick Woodward, Owner, Woodard Insurance Services

Policies Needed to Make District Geothermal Work

The Code of Iowa's silence as to whether a district geothermal heating and cooling system could be considered a municipal utility or not, required additional legal expertise and extra careful attention to detail in funding and implementing the DGHC system and its associated policies. Several policies needed to be developed to implement the West Union DGHC including a lease agreement with a third-party to maintain and operate the system. In West Union's case, a group of the committed system users formed a limited liability company to operate as the third-party leasing the system from the city. The users group is establishing an agreement with another third-party for expertise to maintain and operate the system as well as collect system user fees. To protect the city's asset, the city developed a policy governing the process for connecting to the system and a set of qualifications for HVAC contractors providing system connection and installation services.

Project Rate and Governance Structure

To develop the DGHC rate and governance structures, the city of West Union contracted with FVB Energy out of Minneapolis, MN to provide a recommended rate structure, a recommended lease agreement amount between the city and the third-party users group, and a recommended governance structure. Bringing in an outside party like FVB Energy with experience working on more than 50 district energy projects across North America was key to getting city and system user buy-in and for peace of mind and risk mitigation.

FVB Energy recommended a three tier tariff.

1. A fixed fee to cover capital amortization costs and fixed operational costs including a leasing fee.
2. A variable charge to cover water pump costs, consumables and repairs.
3. A variable charge to cover any possible thermal imbalance for the field wells.

The minimum required tariff to cover all estimated costs discussed above (exclusive of leasing fee) is shown in the table below.

Capacity Fee (water):	4.1	$/gpm/month
Consumption Charge (water):	0.07	$/1,000 gallon
Consumption Charge (thermal):	2.0	$/MMBtu/year
Tariff escalation: • Capacity Fee in line with annual inflation (or lower). • Consumption Charges in line with movements in prices of electricity, water and chemicals.		

Based on information provided to them by the project team and FVB's study of the situation FVB Energy concluded this minimum required tariff gives a total customer buildings net saving of approximately $11,000 annually that would theoretically allow for a higher tariff and consequently a leasing fee to be paid by the operator to the city. However, although there are net savings in total, FVB Energy projected that over 25% of all Customers are projected to have a net loss based on the estimates made to date.

The biggest factor in this result is the capacity fee, which is required to cover fixed costs. If additional customers were included, the fixed costs could be spread over a wider base, thus reducing every customer's costs.

Risk Mitigation

As is often the case, as it should be, local governments are in the business of risk mitigation and that definitely held true for development and implementation of the DGHC system. A series of steps were taken to minimize project risk to the city.

The city mitigated first and foremost much of the upfront financial risk by securing federal funding from three different sources to pay for all of the DGHC system external to the buildings including well field, pumping infrastructure and distribution lines. While this approach greatly reduced project financial risk, some risk remains as the city must perform to the requirements of the funding entities. A second key approach to minimizing risk and leveraging system capacity was the variety of services made available to potential users to reduce base load energy within their buildings. The securing of experienced design and construction firms to design and install the system was a chief risk mitigation strategy. To further reduce risk on the operations side, the city reached out to several experienced district system operators to learn from them and to get multiple estimates on the expected maintenance, operations and administrative costs of the system. Providing a variety of targeted planning and design services to potential system users that resulted in the most likely potential users having a business case developed for them to make an informed decision as to whether to sue the system or not was an effective strategy to reduce the risk that no one would use the system.

To reduce the risk of system and environmental damage and down time for system users, the system design consultant, IBC Engineering Services, developed a set of system leak emergency procedures. In addition, a procedure for connecting new users to the system and a bi-weekly, monthly, and annual routine maintenance and monitoring schedule were developed.

Another risk management tool utilized by the city was a requirement for system testing at construction completion and a one-year warranty on the system following construction. Finally, contracting with an experienced district system development consultant and working with the city's legal counsel to develop the rate and governance structures and legal agreements further reduced system risk.

Project Cost and Funding Sources

The district geothermal heating and cooling system project costs and funding are as follows.

System Costs
$860,000 - geothermal distribution system (pipes, manifolds, building connections)
$1,460,000 - well field

System Funding
$1,000,000 - Community Development Block Grant (Iowa Economic Development Authority)
$860,000 - Energy Efficiency Conservation Block Grant (Department of Energy)
$500,000 - Climate Showcase Communities (Environmental Protection Agency)

District Geothermal System Operations and Maintenance

As mentioned in the risk mitigation section, the city of West Union obtained at least three estimates of the likely operations, maintenance, replacement, expansion and administrative costs. All three estimates, while having some potential variables, were pretty similar in the most

important arena, the arena of annual system costs with an annual estimated cost of approximately $30,000 excluding any lease fee the city may decide to charge the third-party users group to lease the system.

Provided below are examples of how two different consultants, IBC Engineering Services and FVB Energy broke down the anticipated annual system costs.

Estimated Annual Operating Costs: Example #1

Operational Cost Assumptions	Qty	Annual Inspection hrs	Annual Repair hrs	Material Cost	Deferred Maintenance Cost (annual)
Pumps	4	8	16	$500	$1,000
VFD's	4	8			$750
Glycol management system	1	16	8	$500	$500
Pumps station	1	4			$500
Manifolds vaults	2	16			$200
Air purge		8			
System flushing (every 5 yrs)		24		$500	
Distribution valves		6			$4,000
Weekly pump inspection (30 min.)		26			
Totals		116	24		
Hourly rates	$30	$3,480	$720	$1,500	$6,950
Annual equipment cost					**$12,650**

Administration Cost Assumptions	Monthly hrs	Annual hrs	Administrative Cost (annual)
Meter reading	2	24	$720
Billing	2	24	$360
Utility locates – One Call	2	24	$720
New connection inspection	4	48	$1,440
Training		16	$480
Pilot project tours	4	48	$1,440
City administrator	8	96	$3,840
Totals	**22**	**280**	**$9,000**

Energy Cost – Climate Control – Each Pump House	$400
Energy Cost – System Pumps	$7,500
Annual Total = Operations & Maintenance + Administration + Energy for 30% Participation in District (based on sq. ft.)	**$29,550**

Estimated Annual Operating Costs: Example #2

Annual Costs for Geothermal System:	
DGHC capital costs, fixed operational costs and overhead	$27,000
DGHC variable operational costs and consumables (water)	$3,700
DGHC variable operational costs and consumables (thermal)	$920
DGHC leasing fee	$0
Total Annual Costs for Geothermal System	**$31,620**

Revenue Potential

The revenue potential for the city is based on determining a lease fee amount to lease the system to a third-party for operations, maintenance and administration. It is anticipated that the city will finalize the lease amount in September 2013. Determining the correct balance of city revenue and energy savings for system users is a delicate balance and essential to recruiting additional system users. The more system users there are, the more potential that exists for revenue generation for the city and cost savings for system users. For that reason, the city is considering a lower initial lease fee to encourage more system users.

If a lease fee of $0 is charged to the third-party system users group, the net annual estimated energy cost savings to downtown property owners is $11,123 based on estimated annual energy cost savings of $42,743 minus the estimated $31,620 annual overall system costs.

Project Evaluation

Several approaches are being taken to evaluate the project on behalf of the city, system users and the system funding partners. Monitoring and evaluation controls are designed into the system to track actual system usage and performance. Pre- and post-system connection energy use and cost data is planned to be collected from system users. Lastly, the Iowa Economic Development Authority has contracted with Urban Imprint to measure the behavioral and attitudinal impact of the overall downtown revitalization project on businesses and residents.

Project Future Steps

Initial next steps for the project include getting the governance and operational agreements in place, the initial set of system customers on line and evaluating the system's performance.

Future steps include recruiting new users to the system, with an eye on larger customers such as the community's regional hospital and school district and potential customers adjacent to the existing system that have expressed an interest in connection. With the addition of new users to the system, a planned future step is the addition of system capacity by installing the well field in city owned Lions Park.

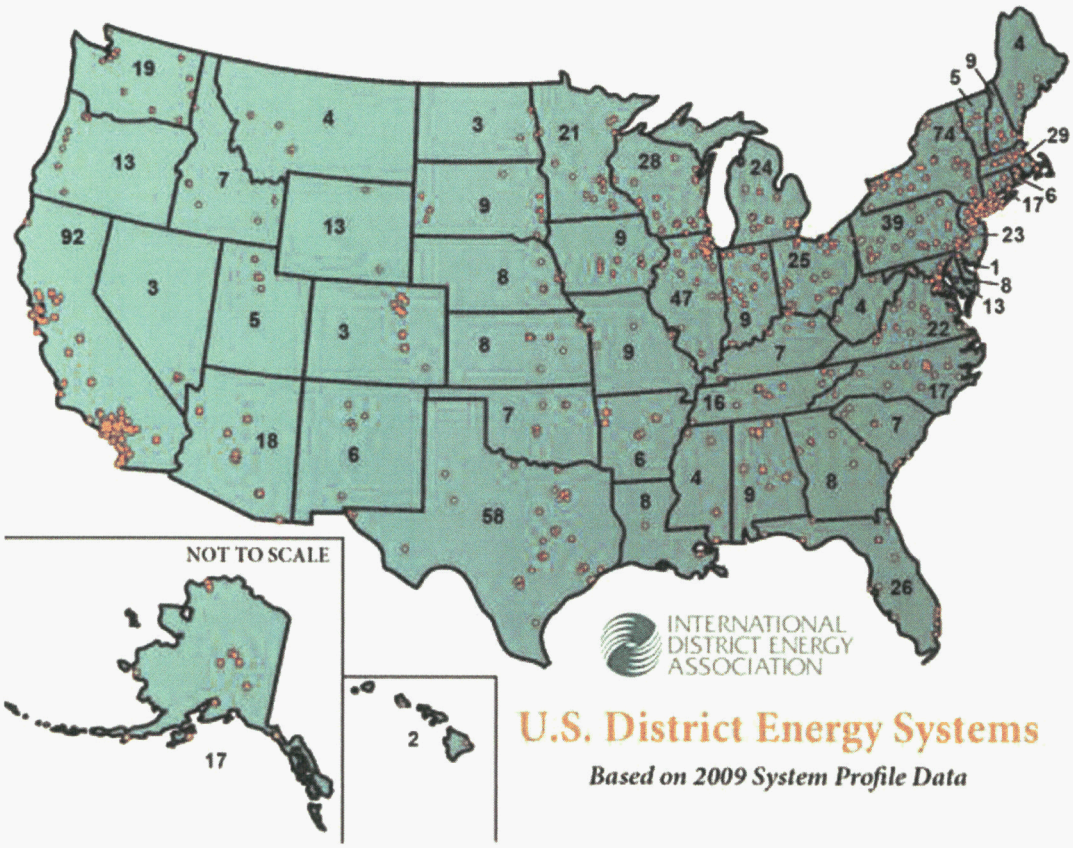
Examples of District Geothermal Systems Outside Iowa

In researching model examples of district geothermal systems, several systems were identified and these systems are listed below. Several of the identified systems are truly geothermal in nature as they are utilizing extreme heat from existing geothermal formations under their community.

Boise, ID
Pagosa Springs, CO
Wyandotte, MI
Klamath Falls, OR
Philip, SD

U.S. District Energy Systems Map (all types)

[Source: International District Energy Association - www.districtenergy.org/u-s-district-energy-systems-map/]



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The Role Renewable Thermal Energy Can Play to Meet New RPS Requirements

December 5, 2013

In the 2013 legislative session, Colorado passed SB-252, which doubled the Renewable Energy Portfolio Standards (RPS) requirement of Tri-State (from 10% to 20%). While CREA has resisted RPS requirements due to concerns that they would result in wholesale power cost increases, the passage of SB-252 shifts the focus to meeting the new RPS mandate at the lowest cost to Colorado Co-Ops. A modification of Colorado's RPS statute to include Thermal Renewable Energy (TRE) will enable Colorado's Co-Ops to minimize the financial impacts of SB-252.

Potential Solution Offered for Consideration:

Prior to the introduction of SB-252, the Colorado Solar Thermal Alliance (STAC) was working on legislation to create a state mandate to fund renewable thermal energy (solar thermal, geothermal heat pumps and biomass) through a small surcharge collected on natural gas and propane sales. These technologies can provide hot water, space heating & cooling, process heat, pool & spa heating, snow melt and electricity generation while reducing carbon emissions from fossil fuels. While this effort was brushed aside by SB-252, it became apparent that these renewable thermal energy sources could be used by the electric cooperatives to meet the intent of SB-252 (reduced carbon emissions, greater use of renewable energy, and job creation) with a modification to Colorado's RPS statute.

Until recently, only traditional electric generating renewable technologies including solar PV, wind, "hot rock" geothermal, etc. were deemed eligible technologies under the states' RPS programs. Thermal renewable energy (TRE) sources were not considered to be eligible as they do not produce electricity. However, a growing number of states (Maryland, New Hampshire, Vermont, Wisconsin, Arizona, North Carolina and Massachusetts) have recognized the overall societal benefits of TRE and have begun allowing utilities to meet their RPS requirements by awarding "Thermal RECs" for these systems.

A Thermal REC is the equivalent thermal energy associated with one MWh of electrical energy, or 3,414,000 Btus of thermal energy. This trend resulted from the efforts of a strong advocacy movement supported by national and regional-based geothermal advocacy groups including the Geothermal Exchange Organization (GEO), National Ground Water Association, National Ground Water Trust, New England Geothermal Professionals Association (NEGPA), and others. As a result, there is growing momentum amongst the states towards incentivizing the use of TRE to meet RPS mandates. U.S. Senate bill H.R. 4850 was passed on September 22, 2012, which would amend the EPACT of 2005 to specifically include thermal technologies for achieving federal energy efficiency goals. The legislation would allow thermal technologies to be used to meet the federal mandate of energy efficiency for any federally-funded building, either new or rehabilitated. The legislation is pending house and executive approval.

Efforts to help members lower their bills through energy efficiency technologies has long been a strong suit of the electric cooperatives. Energy services including geothermal heat pumps and solar thermal systems have been used by electric co-ops to reduce consumers' energy bills while improving the financial health of the distribution cooperatives. Indeed, electric Co-Ops have been electric utility pioneers in developing these RTE services. In Colorado, DMEA has demonstrated the value in promoting energy efficient GHPs to meet efficiency goals while improving system load factor and margins. Valley Electric in Nevada and Lakeland Electric in Florida developed nationally recognized solar hot water leasing program.

The cooperatives can and should lever the TRE service model to meet the goals created by SB-252. By modifying the language of the existing RPS legislation to include renewable thermal energy, the

cooperatives will be able to take an environmental leadership position, open the door to new revenue streams for the electric co-ops, and provide new energy savings solutions to their members. TRE technologies can provide new customer service and revenue opportunities for co-ops and provide a boost to local economies, without increasing electric power costs or cannibalizing electric sales.

The opportunity exists for Colorado's electric cooperatives to lead the development of a modified RPS bill that includes thermal renewable energy, enabling them to be seen as leaders and innovators, while meeting the mandate to provide affordable energy for their members. Much work will need to be done for this to be accomplished, but the door to make this a viable option was born in the political battles of the 2013 legislative session.

Possible Impacts

Per the Fiscal notes developed for SB-252 Colorado's electric cooperatives (Tri-State and IREA) will need to increase their renewable energy portfolio by 1,335,799 MWh to meet their 2020 mandate. This mandate could be met by purchasing RECs (one REC equals 1,000 kWhs (1 Mwh) of electric production from an eligible source). At today's western wind prices of approximately $1.00 per REC, meeting the 2020 SB-252 requirement with RECs would cost $1.3 million per year.

Utility engineers have expressed concerns of incorporating a high promotion of intermittent renewable resources in utility portfolios in a cost-effective manner. Geothermal energy is available 24/7 and solar thermal usually includes 24 hours of storage. These technologies help diversify, balance and stabilize the renewable energy mix – reducing overall backup infrastructure costs.

Geothermal Heat Pumps: offsets and benefits

An average (4 ton) residential ground source heat pump installation saves approximately 100,000,000 Btus of thermal energy per year in Colorado, or 30,000 KWh TRE equivalents per year (30 thermal RECs). The installation of 45,000 GHP residential 4 ton systems across the co-op system over the next 7 years (6,500 systems per year) would meet the SB-252 2020 mandate. These thermal energy savings come primarily from the reduction of propane, fuel oil and natural gas used for space and water heating, with smaller savings from improved air conditioning efficiency. While saving significant thermal Btus, each GHP retrofit would actually increase annual (winter) kWh use per home by approximately 4,675 kWh.

Assuming a distribution co-op electric sales margin of $.02/kWh, each GHP retrofit would add roughly $100 per year to a distribution co-ops bottom line. The cumulative effect of 45,000 GHP installations would increase distribution co-op margins by $4.5 million per year. The generation Co-Ops would supply an additional 210,375 Mwh of annual off-peak (winter) sales. At a generation margin of $0.015 per kWh this would increase generation margins by $3.2 million per year. The collective benefit to the co-op network would be $7.6 million in new margins, while offsetting a conventional REC expense of $1.3 million, or a total benefit of approximately $9 million per year. These incremental revenues would be partially offset by program implementation costs.

Solar Thermal: offsets and benefits

Solar thermal energy can be used for domestic water heating, space heating, pool and spa heating, and process heat.

A basic residential solar water heating system in Colorado (two 4'x10' panels and a 80g storage tank for a family of 4) can save approximately 9,000 kWh (9 thermal RECs) if offsetting a propane or natural gas water heater of average efficiency. The same system will save over 6,000 KWh of electricity if offsetting

an electric water heater. When such a system offsets a propane or gas water heater, the remaining backup water heater is often switched to an electric heater. The back-up electric heater takes care of 10% to 20% of the total water heating load, and this generates new sales for the Coop (primarily winter loads during cloudy spells).

Many residences using an expensive heating fuel like propane will install larger systems with 5 to 10 panels and a larger storage tank. These systems are called combination systems, addressing both water heating and space heating. Also, commercial customers with high hot water usage can install much larger arrays (hotels, restaurants, laundries, dairies, farms, greenhouses, pools, carwashes, etc).

Per NREL-validated calculations in the solar thermal roadmap of CO, an average solar thermal system with five 4x10' panels has a power capacity of 12.5KW and offsets 1,297 KWh of consumption per KW capacity (using the average mix of natural gas/propane/electricity and the average mix of heating functions reported by EIA for the state of CO). As a result, an average solar thermal system offsets above 16,000 KWh, or 16 thermal RECs per year per system. It would require roughly 83,500 average solar thermal systems to meet the additional SB-252 2020 requirement.

Also, on all solar thermal system, new pumps are added to the system, and consume roughly 2% of the thermal energy they offset. These loads represent new sales for the Coops, typically occurring between 9 am and 3 pm. Finally, solar thermal systems include 24 hours of storage, helping to shave peak and base loads, and relieving grid stress.

Although solar thermal systems can offset any heating fuel, because the cost of propane and electricity is 5-fold that of natural gas, utilities can expect a much higher penetration of buildings on propane or all-electric. In particular, propane customers show a strong interest in combination solar thermal systems that address both water and space heating: the recent rise in propane prices have made these customers sensitive to their propane bill, and they already have the heating distribution systems that solar thermal systems require.

United Power, in partnership with the Governor's Energy Office matching grant funds of 2011, successfully installed such solar thermal systems. This presents an opportunity to both receive RECs, new electric sales to operate solar circulator pumps, and new electric sales from switching people's back-up water heating from propane to electric.

Systems can provide a new member service that provides revenue from on-bill collection or financing. A utility like Lakeland Electric in Florida actively markets solar thermal systems in this manner. Lakeland Electric reports multiple benefits from its solar thermal program: happy solar customers, system-wide cost savings and positive PR in its community.

Summary

The Colorado Solar Thermal Alliance has been pursuing a dialog with Colorado efficiency and renewable energy groups and key state legislators to include Renewable Thermal Energy in our state's renewable energy policy. Renewable Thermal Energy can offer Colorado's co-ops the opportunity to meet the intent of SB-252 without increasing wholesale or retail electric rates. A joint legislative effort has a good chance of success and the Renewable Thermal alliance is interested in working with the state's electric cooperatives to meet this objective.